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(54) Tensioner for driving belt

(57) Tensioner for belts comprising a stationary structure (3), an arm (4) movable with respect to a shaft (7) of the stationary structure, a torsion spring (6), a pair of dampening cones (8), (9) associated with the stationary structure and the arm, a compression spring (10) acting on the dampening cones. The mean radius of the cones is smaller than the maximum radial dimension of the torsion spring. The value "l" of the arm is correlated to the mean radius of the cones determining a frictional dampening between the cones smaller than that existing between the shaft and the rotating arm.

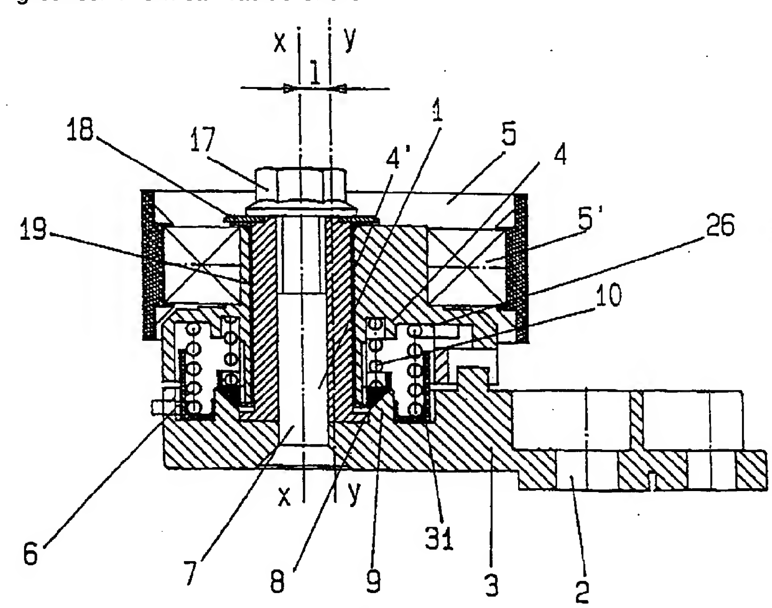

FIG.2

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Description

The present invention refers to improvements to tensioners used in power transmissions comprising a belt and at least two pulleys, a driving pulley and a driven pulley, respectively.
In such power transmissions, the tensioner acts with one of its pulleys on the back of the belt to tension it to a value that guarantees the normal working of the power transmission.

It is known to use a tensioner for driving belts comprising a stationary structure, a lever arm supported by the stationary structure and movable with respect to the latter, a pulley associated with the arm, first mechanical spring means associated with the stationary structure and the arm to move the arm with respect to the stationary structure and to urge the pulley on the belt, frictional dampening means associated with the stationary structure and the arm to dampen the movements of the arm rotating with respect to the stationary structure in both the rotation directions.
The stationary structure comprises a shaft having a longitudinal axis mounted in a stationary manner with respect to the movements of the rotating arm and the arm has a portion carried by the shaft so as to rotate relative thereto.

A tensioner as set forth is described in the U.S. patent 4,473,362.

This tensioner is provided with a torsion spring comprised and associated at the ends with the rotating arm and the stationary structure and a plastic spring holder ring delimited by cylindrical walls and supported by the basement of the stationary structure coaxially to the shaft. The lever arm lengthens considerably starting from the tensioner shaft over the radial encumbrance determined by the torsion spring and carries at its free end an idle pulley.

During operation the last turn of the torsion spring for the rotation of the lever arm clamps on the lateral wall of the spring holder element which is urged against rotating parts of the tensioner giving rise to a frictional dampening.

In said tensioner the dampening is proportionally linked to the force of the torsion spring.
Moreover, tensioners having the cited characteristics are known, in which however the dampening has constant values independently of the values of the forces of the mechanical spring means that urge the tensioner pulley towards the belt.

Such a tensioner is described in the U.S. patent 4,596,538. In this tensioner, a flat torsion spring wound coaxially to the shaft is arranged in a first plane and a dampening device, formed by two plates opposite to each other and second mechanical spring means, is arranged in a second plane lying below the first one.

One of the plates is mounted coaxially to the shaft, rotates with the arm and is axially movable relative to the second plate integral with the stationary structure.
The second spring means comprise a wavy spring that urges one of the plates against the other to determine the desired frictional value during the rotation of the arm and to compensate the wear appearing in the form of dust due to the friction between the plates themselves.
The tensioner arm extends considerably over the radial encumbrance of the flat torsion spring and the underlying damper and carries at its end an idle pulley destined to tension the belt.

A further tensioner having a constant frictional dampening is described in the U.S. patent 4,971,589.
This tensioner provides a flat torsion spring wound coaxially to the shaft and on itself.
The stationary structure provides a cup-shaped envelope having a base to which the shaft is secured and lateral walls ending in an outwards flaring shaped according to a conical surface portion with inclination converging towards the shaft. In its turn the arm comprises a conical surface complementary to that of the envelope. A layer of suitable antifriction material is arranged between the two conical surfaces. The second mechanical means are represented by a wavy spring that, from the tensioner upper part, urges the conical surface of the arm against that of the envelope.

The conical surfaces are adopted in order to oppose the "cocking" phenomena, i.e. the inclination of the tubular portion of the arm on the shaft. The "cocking" is due to the fact that the horizontal force transmitted by the belt to the pulley is applied at a certain distance from the basement to which the shaft is secured originating thus with a bending moment the cited inclination and a consequent wear of the antifriction material layer between the shaft and the portion of the arm rotating around the shaft. In this tensioner the dampening is determined by the friction due to the movements relating to the rotation between said conical surfaces at the periphery of the envelope and assumes high values due to the sensible mean radius of the conical surfaces measured with regard to the axis of the shaft.

A further tensioner is known from U.S. patent 4,826,471, which comprises first mechanical spring means formed by a torsion helical spring mounted coaxially to the shaft between the arm and the stationary structure.

The tensioner makes use of a dampening device comprising two cams having inclined surfaces cooperating to each other and second mechanical spring means formed by a compression spring. One of the cams is mounted on the lower base of the arm and the second cam having the inclined surface directed towards the first one is mounted coaxially to the shaft on which it can slide only axially through a guide that notches longitudinally the shaft.

The second cam is urged against the first one by the compression spring disposed with the lower end on the stationary basement, coaxially to the shaft and inside the torsion spring.
The arm lengthens over the envelope comprising the two springs.

During operation, in relation to a predetermined direction of rotation of the arm, one of the cams goes up with its inclined surface towards the other one compressing the spring which unloading its force obliges the cam to go down towards the other one with a movement of the arm against the back of the belt.
In practice, in this tensioner the torsion spring and the compression spring act as they were in parallel to tension the belt.

The working of the dampening device is unidirectional.
The tensioners of the state of the art just set forth show also a dampening effect independent of the dampening device. Said independent dampening is due to the friction arising between the shaft and the portion of the arm in rotation around the shaft since the force of the belt acting on the pulley at the end of the arm is balanced by an equal and opposite reaction directed by the portion of the arm in rotation around the shaft towards the shaft. Consequently, the tensioners of the state of the art provide a dampening, even if minimum, due to the essential structural parts and additional dampening devices that can be grouped in two types different from each other and precisely, a first type in which the dampening can depend on the force of the spring or also unidirectional and a second type in which the friction is constant for both the directions of rotation of the arm.

The present invention includes only dampening devices of the second type.
The tensioners provided with devices of the second type have in a lot of realizations frictional surfaces exposed to the outside with the possible risk of embedding particles of the surrounding environment and consequent rising of jamming. Moreover said tensioner are based on dampening devices which make use substantially of very large frictional surfaces and heavy compression loads with a consequent not indifferent wear in time with formation of dust and risks of jamming between the frictional surfaces in the relative rotary motion.

The Applicant has found that it is possible to improve the tensioners of the state of the art as regards the regularity of working, its lifetime, as well as the resistance to the "cocking" phenomenon making use of a dampening unit comprising opposite conical surfaces, subjected to pressure between them by mechanical spring means and by linking the frictional dampening percentage obtainable from said unit to that obtainable from the friction produced between the surfaces of the tensioner stationary shaft and the tensioner arm rotating around said shaft.

More particularly, it was found that it is possible to achieve the cited improvements when the value of the arm measured between the centres of the shaft and the pulley acting on the belt and the value of the mean radius of the conical surfaces are correlated to each other in a predetermined manner to generate when the arm rotates relative to the stationary structure a frictional dampening between the conical surfaces sensibly smaller than the frictional dampening between the shaft and the arm portion carried by the shaft, for example a dampening comprised between 15 and 40%, also for example a dampening of 20% of the total dampening.
Therefore the object of the present application is a tensioner for driving belts comprising a stationary structure, a lever arm carried by said stationary structure and movable relative to said stationary structure, a pulley associated with the arm, first mechanical spring means associated with the stationary structure and the arm to move the arm with respect to the stationary structure and to urge the pulley on the belt, frictional dampening means associated with the stationary structure and the arm to dampen the movements of the arm rotating with respect to the stationary structure in both the rotation directions, said stationary structure comprising a shaft having a longitudinal axis and being mounted in a stationary manner relative to the movements of the rotating arm, said arm having a portion carried by the shaft so as to rotate with respect to the shaft, said tensioner being characterized by the fact that:

a) said dampening means comprise a pair of annular elements provided with conical surfaces, first and second respectively, and second mechanical spring means, said first surface comprising frictional means and being mounted coaxially to the shaft and axially movable with respect thereto as regards the second surface, said second spring means placing the conical surfaces upon each other into contact under pressure, said conical surfaces having the mean radius smaller than the maximum radial dimension of the first mechanical spring means;

b)the length values (l) of the arm between the centres of the shaft and the pulley and the mean radius values (Rm) of the conical surfaces are correlated between them in a predetermined manner to produce when the arm rotates relative to the stationary structure, a frictional dampening between the conical surfaces smaller than the frictional dampening occurring between the shaft and the portion of arm carried by the shaft.
Hereinafter the value of the mean radius Rm of the conical surfaces is the value that for a determinate height h of the conical surface is measured at half height.

Preferably the tensioner is characterized by the fact that the ratio between the length of the arm and the mean radius of the conical surfaces is comprised between 0.1 and 0.5.
Also preferably, the tensioner is characterized by the fact that the arm comprises a cylinder mounted in an eccentric manner with respect to the longitudinal axis of the shaft, said pulley being mounted in an idle manner on said cylinder by interposition of a bearing.
In some particularly advantageous embodiments, the tensioner is characterized by the fact that in an axial section of the tensioner the angle (β) between the line of the

conical surface in the cutting plane and the longitudinal axis of the shaft is comprised between 20 and 70 degrees.
In a preferred embodiment the tensioner comprises means of connection to the rotation and contemporaneously means of guide to the axial movement between the element comprising the first conical surface and the arm.
The two conical annular elements can be made of plastic material or metallic material, for instance a bronze and brass alloy or of polyamide.

In particular and preferably, it is provided to use an annular element of bronze alloy axially movable along the shaft opposite to a stationary annular element of plastic material charged with fibers, for example aromatic polyamide fibers; it is possible to use two annular elements, both of plastic material.
Alternatively to the previous solution, the annular element having a conical surface, for example of bronze alloy, could be mounted on the stationary structure with ways for the axial sliding along which said annular element is urged by a compression spring against a further annular element having a complementary conical surface fixed to the lever arm. Further characteristics and advantages will better appear from the detailed description of a preferred, but not exclusive, embodiment of a tensioner for driving belts according to the present invention.
Said description will be made hereinafter with reference to the attached sheets of drawing, supplied only by way of non limiting example, wherein:

- figure 1 is a diagrammatic view of a driving device provided with a flexible belt and relative tensioner;
- figure 2 is an axial sectional view of a tensioner according to the invention;
- figure 3 shows the parts of the tensioner of figure 2 taken the one out of the other in axial direction;
- figure 4 is an axial sectional view of the arm of the tensioner of figure 2;
- figure 5 is a cross sectional view of the shank of the arm of figure 4 in larger scale;
- figure 6 is a longitudinal sectional view of an annular element of the dampening means of the tensioner;
- figure 7 is a top view of the element of figure 6 in enlarged scale.

Figure 1 shows a flexible belt "a" in a driving device provided with two pulleys, a driving pulley "m" and a driven pulley "c", respectively.

The belt of figure 1 is represented by sake of simplicity only with its longitudinal development; said belt can be of any known type, for example a toothed belt of elastomeric material used in an internal-combustion engine for the control of the camshaft in a motorvehicle.
Further, figure 1 represents diagrammatically by a circle the pulley of the tensioner 1 having a rotation centre Y, which is mounted on a support having a centre X. The features of the tensioner forming the object of the present application are described later, illustrated in general in figure 2 and more in detail in figures 3-7.
The tensioner 1 shown in figure 2 comprises a stationary structure 3, a lever arm 4, preferably of aluminium, carried by the stationary structure, a pulley 5 associated with the arm, a torsion spring 6 associated with the stationary structure and the arm to move this latter relative to the stationary structure, frictional dampening means associated with the stationary structure and the arm to dampen the movements of the arm rotating in both the rotation direct ions relative to the stationary structure.
The stationary structure comprises a shaft 7 having a longitudinal axis mounted in a stationary manner with respect to the movements of the rotating arm. The arm comprises a portion 4' supported by the shaft 7 so as to rotate relative thereto.
The structure 3 is also anchored to parts of the engine, for instance to the face of the engine through holes 2 inside which appropriate fastening means (not shown) are introduced.

The dampening means comprise a pair of annular elements provided with conical surfaces 8, 9 and a compression spring 10 inside and coaxial to the torsion spring 6. The angle between the cones can range between 20 and 70 degrees and the dampening changes too. In the example of figure 2, the angle of the cones with respect to the longitudinal axis is of 45 degrees.
The whole dampening device is positioned inside the torsion spring.
In the application to a toothed belt driving device the tensioner makes use of an arm comprising an upper cylindrical portion 4' having the axis YY eccentric relative to the axis XX of the shaft 7.

Pulley 5 is mounted in an idle manner around the cylindrical portion of the arm by interposition of a bearing 5'.

The length values (l) of the arm measured between the centres of the shaft and the pulley and the values of the mean radius (Rm) of the conical surfaces are characteristics of the invention.

It was found that said values must be correlated to each other in a predetermined way to originate, when the arm rotates relative to the stationary structure, a frictional dampening between the conical surfaces sensibly smaller than the frictional dampening between the shaft and the arm portion carried by the shaft.

To achieve a reduced wear of the material of the cones and a longer lifetime of the tensioner maintaining an adequate resistance to cocking, the values of the cited parameters "l" and "Rm" are correlated to determine a dampening due to the friction between the cones comprised between 15% and 40% than the total one due to the friction between shaft and arm portion and dampening device.

In the particular example described, the ratio between the parameter "l" and the mean radius of the conical surfaces is equal to 0.4.
Preferably in absolute value the values of "l" in the case of the application of figure 1 are comprised between 3 and 7 mm and the values of Rm between 10 and 17 mm.

Moreover it was found particularly adequate in relation to the predetermined parameters "l" and "Rm" to realize the structural part and the dampening device as described in detail hereinafter.

As clearly visible in figure 3, the tensioner 1 comprises a shaft 7 defined by various parts consisting of a pivot 12 and a steel sleeve 13 placed around the pivot. The pivot has a head 14 housed in a seat 15 of the stationary structure and a cylindrical body provided with an end thread 16 projecting towards the inner space of the tensioner. In its turn the steel sleeve has the base supported by the stationary structure with which it is integral through a nut 17 screwed on the thread of the pivot as far as to press through a flange 18 on the upper end of the sleeve.

Between the arm and the sleeve and between the arm upper end 20 and the flange 18 there is a layer 19 of antifriction material, for instance said layer is constituted by a bronze mesh impregnated in particular with plastic material and for example with polytetrafluoroethylene.

The arm, advantageously formed in a single piece, comprises various parts to perform different tasks.

In particular the arm comprises:

- a tubular member 22 to be mounted around the shaft;
- an upper full cylinder 4' arranged in an eccentric manner relative to the axis of the tubular member and extending between two bases, an upper base 20 and a lower base 23, respectively, for a short length with regards the tubular member; the pulley with its bearing is applied on said cylindrical portion;
- a sectional reduction from the periphery of the lower base of the arm towards the centre of the tubular member as far as to form a shank 24 extending along the remaining part of the tubular member; said shank is useful both to increase the area of contact with the antifriction layer around the sleeve and to form, as it will be explained later, some guide grooves for the annular element 8 preserving the shaft 7 from possible notches for the same purpose;
- a lateral cylindrical wall 25 extending in a projecting manner from the periphery of the lower base 23 as far as a minimum distance with respect to corresponding lateral walls of the stationary structure; said wall is useful to enclose the dampening device preserving it from the dust coming from outside;
- a hole 26 (figure 1) obtained on the lateral wall 25 to receive one end of the torsion spring 6.

Very advantageously the shank 24 extends towards the stationary structure in absence of contact. Said characteristic permits fittings of the length of the tubular member in presence of thermal expansions avoiding therefore the rising of a contact between the lower end of the shank and the stationary structure with a consequent risk of blocking the rotation of the arm originated by the torsion spring to tension the belt.

In one embodiment of the present invention now described, the steel sleeve has an outer diameter of 16 mm and the length of the tubular member 22 is of 32 mm.

In accordance with one embodiment of the invention the friction coefficient between sleeve and layer 19 is of 0.12 and that between layer 19 and arm of 0.20 so that this latter pulls the layer into rotation.

In its turn the stationary structure comprises a basement 27 on which a cavity 28 is obtained. Said cavity 28 is delimited by a cylindrical lateral wall 29 projecting towards a corresponding lateral wall of the lever arm; therefore the lateral walls of the arm and of the stationary structure form the cited substantially closed cylindrical space where the springs and the dampening device are arranged.

The cavity 28 forms a supporting and fastening seat of the element comprising the second conical surface 9 of the dampening means.

In the embodiment of figure 3 the cavity is shaped in such a way that the same material of the basement corresponds to the annular element having the conical surface 9.

The lateral wall of the cavity on the basement comprises a hole 30 wherein one end of the torsion spring 6 is fixed. Further, a plastic annular crown 31 is foreseen on the basement, said plastic annular crown being arranged coaxially to the annular element having the conical surface 9 to form a support for the end of the torsion spring 6. Alternatively, it is possible to foresee of realizing a single plastic unit shaped in a way corresponding both to the annular element having the conical surface and the crown for supporting the helical spring; said unit is inserted with a force into a corresponding cavity obtained in the basement material.

A further particular characteristic of the invention is given by the realization of the dampening device as pointed out in the detailed figures 4 to 7.

As it is possible to see in said figures, the element comprising the first conical surface is applied around the cylindrical shank 24 of the arm and between the arm and the shank there are means of connection to the rotation of the element together with the shank and means of guide to the axial movement of the element itself in respect to the second conical surface.

The connecting and guiding means comprise teeth 33 extending radially from the inner annular surface of the annular element towards the shaft and grooves 34 in a number corresponding to the teeth obtained on the outer surface of the shank; the grooves 34 are formed and extend in axial direction to the shank.

The annular element 8 inserted together with the teeth 33 in the grooves 34 is urged with a pressure against the element having the conical surface 9 by the compression spring arranged coaxially to the shaft 7, inside the torsion spring 6 and with one end in contact with a seat 23' of the arm lower base 23.

Very advantageously, the annular element having a conical surface 8 is made of a brass and bronze alloy and the annular element having a conical surface 9 is of plastic material.

According to some embodiments the annular element having a conical surface has a height value h (figure 6) comprised between 2 and 20 mm, preferably between 3 and 10 mm, and a radius Rm between 10 and 17.5 mm. According to one embodiment of the invention the friction coefficient between the cones 8 and 9 is equal to 0.20 and the compression spring 10 exerts on the cones an axial force of 30 N (Newton).
According to one application of the tensioner the force that the belt exerts on the tensioner arm is of 200 N. The just described tensioner operates as follows.

In presence of pulsating forces, for instance the oscillating forces produced by the springs of the valves of the camshafts, a variation of the force transmitted by the belt to the pulley of the tensioner takes place with a consequent balancing reaction of equal value on the shaft. The arm tends to rotate finding an obstacle in the friction generation that arises between the surfaces of contact in the relative rotary motion of the shaft and the portion of the arm around the shaft.
Consequently a first dampening action takes place.
At the same time the cone 8 transported by the arm 4 and integral therewith through the connection between the teeth 33 and the grooves 34, is obliged to rotate remaining subjected to the action of the compression spring 10 that urges it with a pressure against the opposite conical surface 9; in such a way a friction is generated between the conical parts coaxial to the shaft together with a dampening action.

The two cited dampenings together impede the tensioner pulley 5 to move away and the arising of risks of a possible skipping phenomenon from the grooves of the driving and driven toothed belts.

The solution of the present invention achieves the pre established aimed purposes through the values cited in the description of the distance "I" between the centres of the pulley and the shaft 7 and those of the mean radius "Rm" of the cones, as well as through the values of their ratio.

In fact, it was found that with equal force transmitted by the belt towards the pulley, equal compression load of the spring 10 on the cones, equal angle of the cones, same materials, the force that must be applied on the arm to overcome the friction on the shaft increases with decreasing values of the arm "I" and the force that must be applied by the belt on the arm to overcome the friction of the cones decreases on decreasing the mean radii of the cones, so that establishing the value "I" then it is possible to control the ratio "I" on "Rm" so as to obtain the wished dampening ascribing however the maximum part to the friction between the shaft and the arm and reducing that of the cones. In such a way a reduction of the wear of the materials of the cones is obtained and their capability of withstanding "cocking" is maintained unchanged in time.
As regards the predetermined value "I", it was found that it is function of various geometric parameters as the value of the angle alpha assumed by the belt on the tensioner pulley, the belt length, the belt materials, the supporting materials of the driving and driven pulleys as for instance the basement and the engine head.
The value of "I" is also function of physical parameters, as the elongation of the belt in time in function of the wear, the modulus of elasticity of the belt.
In particular the expansions to which the whole system is subject determine a variation of the belt development which is balanced by the movement of the pulley of the present tensioner.

It was found that the value "I" of the arm can range between 3 and 7 mm.
For example, it was found that the minimum value "I" of the arm to maintain constant tension values in the belt branches is of 5 mm in the case of a belt having a development of 1200 mm, an angle alpha (α) of 70 degrees, an engine of aluminium, a permanent elongation of the belt of 0.1%, a variation of temperature comprised between - 30 degrees and + 130 degrees celsius.
In particular it is pointed out that the dampening due to the friction between the shaft and the portion of the arm can determine a certain wear of the antifriction material interposed therebetween, but thanks to the characteristic of the shaft surrounded by a tubular member extending in practice for the whole length of the shaft, a specific pressure takes place which has such a value to limit considerably wear phenomena.
Also it is understood that the invention is not strictly limited to what previously described, but it includes also all those solutions and alternative expedients, even if not explicitly described here, but easily deducible by anyone skilled in the art on the basis of the present inventive idea.

Claims

1. Tensioner (1) for driving belts comprising a stationary structure (3), a lever arm (4) transported by said stationary structure and movable relative to said stationary structure, a pulley (5) associated with the arm, first mechanical spring means (6) associated with the stationary structure and the arm to move the arm with respect to the stationary structure and to urge the pulley on the belt, frictional dampening means associated with the stationary structure and the arm to dampen the movements of the arm rotating relative to the stationary structure in both the directions of rotation, said stationary structure comprising a shaft (7) having a longitudinal axis and being mounted in a stationary manner relative to the movements of the rotating arm, said arm having a portion transported by said shaft so as to rotate with respect to said shaft, said tensioner being characterized by the fact that:

   a) said dampening means comprise a pair of annular elements provided with conical surfaces (8), (9), first and second, respectively, and second mechanical spring means (10), said first surface comprising frictional means and being

mounted coaxially to the shaft and movable axially with respect thereto as regards the second surface, said second spring means placing the conical surfaces upon each other into contact under pressure, said conical surfaces having the mean radius smaller than the maximum radial dimension of the first spring mechanical means;

b)the length values (l) of the arm measured between the centres of the shaft and the pulley and the mean radius values (Rm) of the conical surfaces are correlated between them in a predetermined manner to produce when the arm rotates relative to the stationary structure, a frictional dampening between the conical surfaces smaller than the frictional dampening occurring between the shaft and the portion of arm carried by the shaft.

2. Tensioner as in claim 1, characterized by the fact that the ratio between the arm length and the mean radius of the conical surfaces is comprised between 0.1 and 0.5.

3. Tensioner as in claim 1 or 2, characterized by the fact that said arm comprises a cylinder mounted in an eccentric manner relative to the longitudinal axis of the shaft, said pulley being idly mounted on said cylinder through interposition of a bearing.

4. Tensioner as in any one of the preceding claims, characterized by the fact that in an axial section of the tensioner the angle (β) between the line of the conical surface in the section plane and the longitudinal axis of the shaft is comprised between 20 and 70 degrees.

5. Tensioner as in claim 1, characterized by the fact that said first conical surface is associated in rotation with the lever arm.

6. Tensioner as in claim 5, characterized by the fact of comprising means of connection to the rotation and at the same time of guide to the axial movement between the element comprising the first conical surface and the arm.

7. Tensioner as in claim 1, characterized by the fact that said element comprising the first conical surface is associated with the stationary structure and the further element having the second conical surface is associated with the arm.

8. Tensioner as in claim 7, characterized by the fact of comprising means of connection to the stationary structure and at the same time of axial movement relative to the shaft.

9. Tensioner as in claim 1, characterized by the fact that said arm rotating around the shaft comprises a first full cylindrical portion followed by a shank (11) having a smaller thickness extending as far as the stationary structure in absence of contact between the shank lower end and said structure.

10. Tensioner as in claim 9, characterized by the fact that said shaft comprises a pivot (12) and a metallic sleeve (13) around the pivot, said pivot having the head (14) housed in a seat (15) of the stationary structure and a cylindrical body having an end thread (16) projecting towards the inner space of the tensioner, said metallic sleeve having a base supported by the stationary structure and being integral with the stationary structure through a nut (17) screwed on the pivot thread as far as to urge through a flange (18) on the upper end 21 of the sleeve 13.

11. Tensioner as in claim 10, characterized by the fact of comprising a layer of antifriction material (19) between the arm and the sleeve and between the upper end of the arm and said flange (18).

12. Tensioner as in claim 1, characterized by the fact that said element comprising said first conical surface is mounted around a cylindrical shank of the arm and between the element and the shank there are means of connection and guide to the rotation of the elements together with the shank and to the axial movement of the element itself as regards the second conical surface arranged on the stationary structure, respectively.

13. Tensioner as in claim (12) characterized by the fact that said connecting and guiding means comprise teeth (33) extending radially from the inner surface of the annular element towards the shaft and grooves (34) corresponding to the teeth and obtained on the outer surface of the shank, said grooves being formed in axial direction to the shank.

14. Tensioner as in claim 12, characterized by the fact that between the arm and the element having the first conical surface a helical compression spring is mounted coaxially to the shaft, said helical compression spring acting between a shank base extended transversely of the longitudinal axis of the shaft and a supporting surface of the annular element.

15. Tensioner as in claim 1, characterized by the fact that:

- said arm comprises a tubular member (22) to be applied around the shaft;
- an upper full cylinder 4' arranged with its own axis eccentric relative to the axis of the tubular member, said full cylinder extending between two bases, upper and lower (20) (23), respec-

tively, for a shorter length with regard to the tubular member;

- a sectional reduction from the periphery of the lower base of the arm towards the centre of the tubular member as far as to form a shank (24) extending for the remaining part of the tubular member;
- a lateral cylindrical wall (25) extending in a projecting manner from the periphery of the lower base as far as a minimum distance with respect to corresponding lateral walls projecting from the stationary structure; a hole (26) obtained on the lateral wall (25) to receive one end of said first mechanical spring means,

said lever arm having said eccentric portion forming a housing for the pulley through interposition of a bearing and said shank having longitudinal grooves to receive corresponding teeth of the annular element comprising the first conical surface of the dampening means.

16. Tensioner as in claim 1, characterized by the fact that said stationary structure comprises a basement (27) where a cavity (28) is obtained, which is delimited by a lateral cylindrical wall (29) directed in a projecting manner towards a corresponding lateral wall of the lever arm, said lateral walls of the arm and of the stationary structure forming a cylindrical space substantially closed wherein the said first and second spring means are disposed, said cavity (28) forming a supporting and fastening housing of the element comprising the second conical surface of the dampening means, the said lateral wall of the cavity on the basement comprising a hole (30) in which one end of the first mechanical spring means is fixed.

17. Tensioner as in claims 15 and 16 characterized by the fact that said first mechanical spring means comprise a helical spring whose end turns lay on the base of the cavity (28) and the lower base (23) of the arm.

18. Tensioner as in claims 15 and 16 characterized by the fact that said second mechanical spring means comprise a compression spring disposed between a groove 23' obtained on the lower base (23) of the arm and the annular element comprising the first conical surface, said compression spring being mounted coaxially to the shaft and inside a torsion spring between the lower base of the arm and the cavity of the stationary structure, with the end turns of the spring inserted in said holes (26) and (30) of the arm and the stationary structure.

19. Tensioner as in claim 16, characterized by the fact of comprising a plastic unit formed by a first part shaped to determine the said annular element provided with the second conical surface and a second part shaped according to an annular crown delimited between the walls of said annular element and an outer cylindrical lateral wall defining a supporting hosing (31) for a helical torsion spring acting between the arm and the stationary structure, the dimensions of said plastic unit corresponding to those of the cavity of the basement where it is forced.

20. Tensioner as in claim 1, characterized by the fact that the second conical surface of the dampening means is a portion of the stationary structure.

21. Tensioner as in claim 1, characterized by the fact that said annular element comprising the first conical surface is made of a bronze alloy.

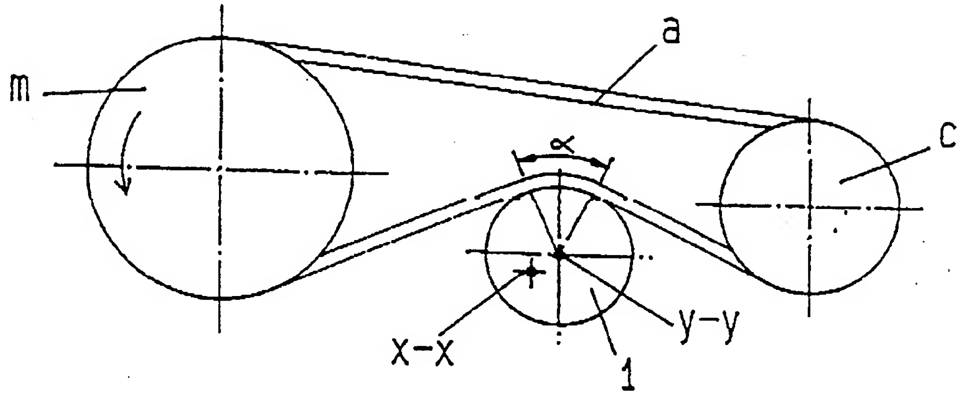

FIG.1

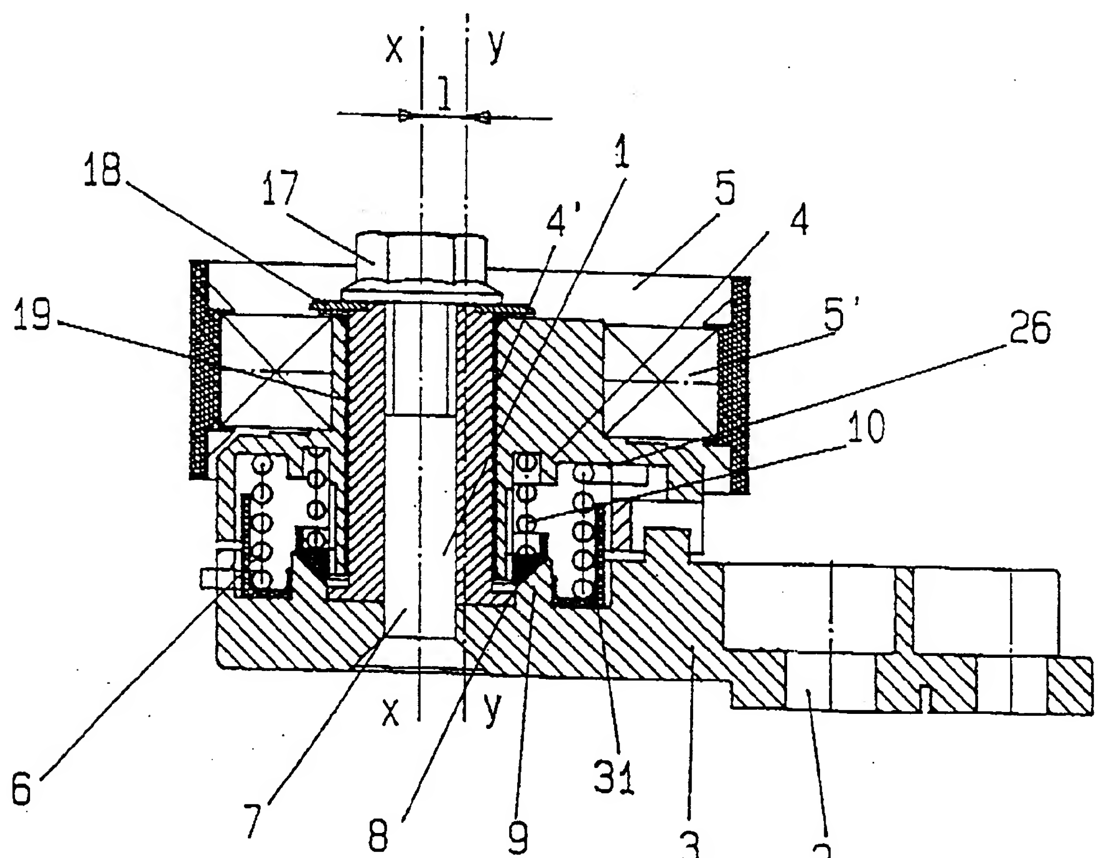

FIG.2

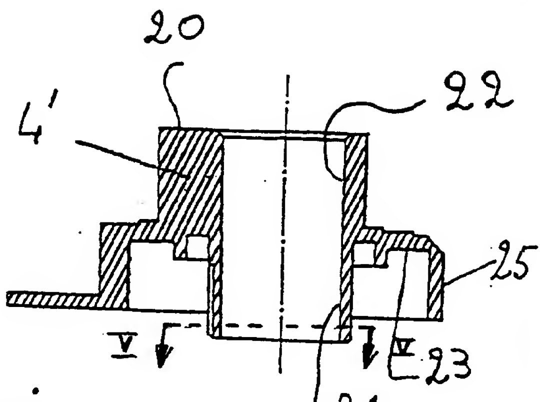

FIG 4

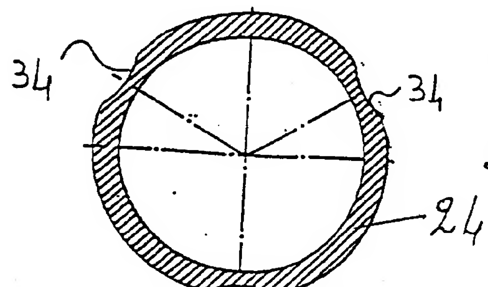

FIG 5

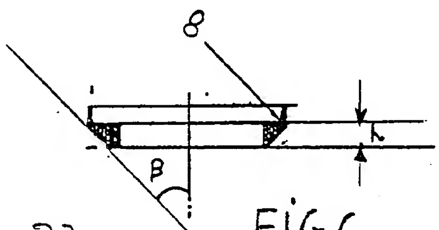

FIG 6

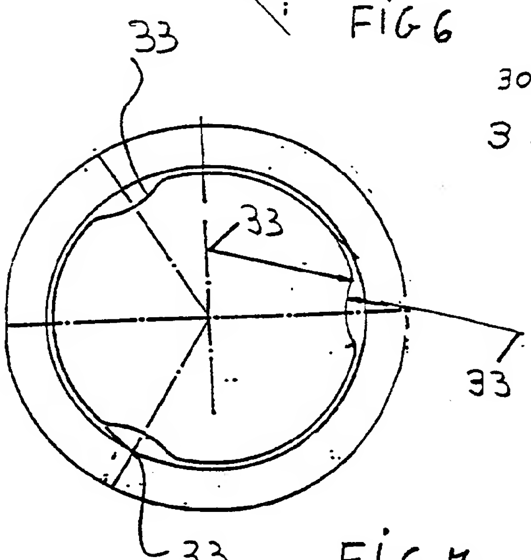

FIG 7

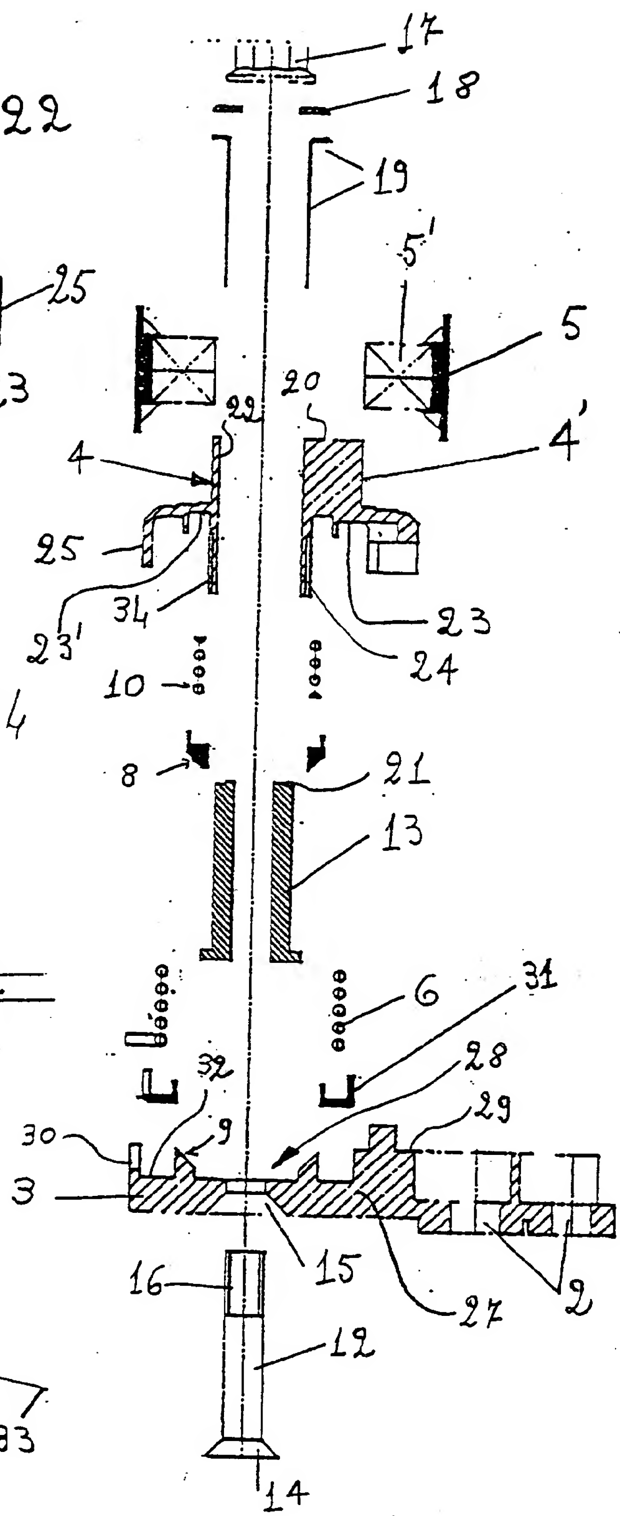

FIG 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 6653

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-C-43 00 178 (FA. MUHR UND BENDER) * column 3; figure 1 *	1	F16H7/12
D,A	US-A-4 971 589 (SIDWELL) * abstract; figure 3 *	1	
D,A	US-A-4 826 471 (MITSUBOSHI) * abstract; figure 2 *	1	
D,A	US-A-4 596 538 (DEWEY) * abstract; figure 5 *	1	
D,A	US-A-4 473 362 (THOMEY) * abstract; figure 3 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
F16H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 January 1996	Flores, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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